Thermal Diffusivity Measurements using Reduced Algorithms

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We have developed techniques for the measurement of thermal diffusivities from reduced algorithms of heat conduction equations. The geometry for these measurements is a cylinder or disk of the material for testing. These techniques rely on a mathematical reduction of the analytical solution of this disk geometry utilizing unique temperature measurement positions and the heated area. Using the resulting formulation the Bessel function solution is reduced to a minimum number of terms. We have obtained an analytical solution for both a central (volume) heating geometry and for edge heating. The thermal diffusivity is obtained by taking the difference of the temperature versus time at the measurement locations. In practice, due to the fact that the higher order terms become negligible after a short time, the exact measurement locations do not need to be used and multiple valves of the thermal diffusivity can be obtained with each determination. Also, exact timing between the heating pulse and the measurement time is not required. We have applied this methodology to stainless steel, graphite and boron nitride determinations with good results.